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New Broadband Square-Law Detector

Several new broadband square-law detectors have been developed. Each has a number of features built into one compact unit. These include:

a. A wide dynamic range,
b. An accurate square-law response over the dynamic range,
c. Good thermal stability,
d. A high-level dc output with immunity to ground-loop problems,
e. The ability to insert known time constants for radiometric applications, and
f. Fast response times compatible with computer systems.

A block diagram of one such detector model is shown in Figure 1. Here the input is fed through step attenuators with an 80-dB range, a wideband IF amplifier (1 to 110 MHz) with a 45-dB gain, and into a detector/amplifier unit. The dc output from this unit is available through a variety of time-constant and filter circuits, a typical example of which is shown. The first two outputs have time constants, one of which is variable; the other two are fast; and the fifth is a frequency which is proportional to the voltage.

The time-constant networks are made up of resistance/capacitance circuits and are isolated by using amplifiers. Since these high quality amplifiers operate at a gain of 1 or 5, thermal drifts are insignificant. The 0-V to 10-V output is used for operation with an analog-to-digital converter for computer applications. This output therefore has a low-pass filter to prevent clock feedback from the computer.

Figure 2 is a detailed diagram of the diode detector and dc amplifier of Figure 1. The amplifier is chopper stabilized. Its thermal drift referred to the input is 0.1 μV/°C; with a gain of 200, the drift referred to the output is 20 μV/°C. The entire circuit is enclosed in a Mumetal, or equivalent, box for radio-frequency-interference (RFI) and magnetic shielding. The RF portion of this circuit is RFI shielded from the remainder, as shown. All outputs from shielded

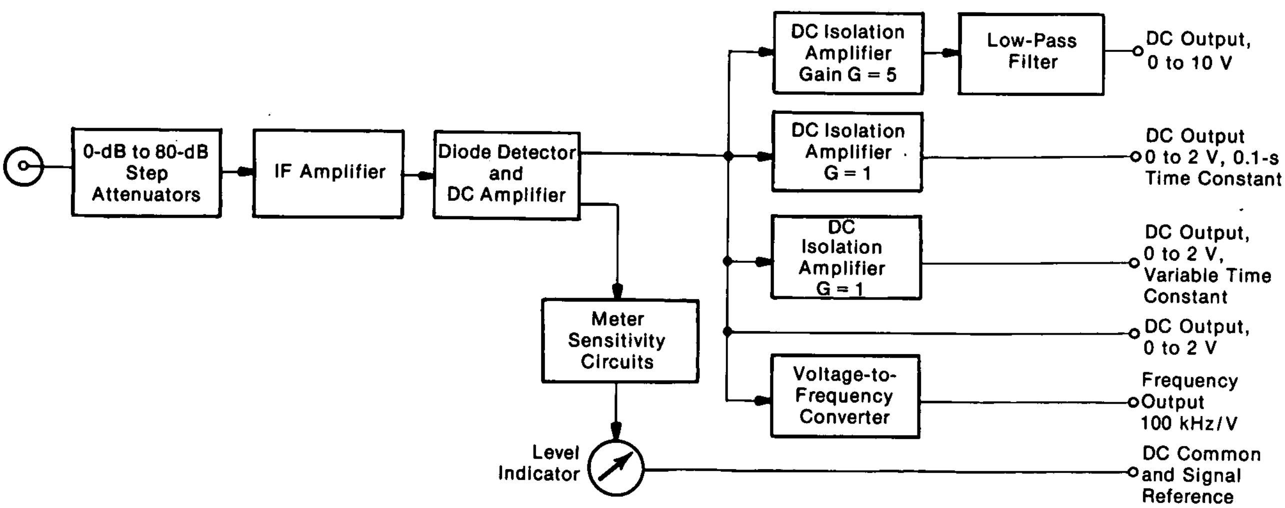

Figure 1. Square-Law Detector Block Diagram

(continued overleaf)

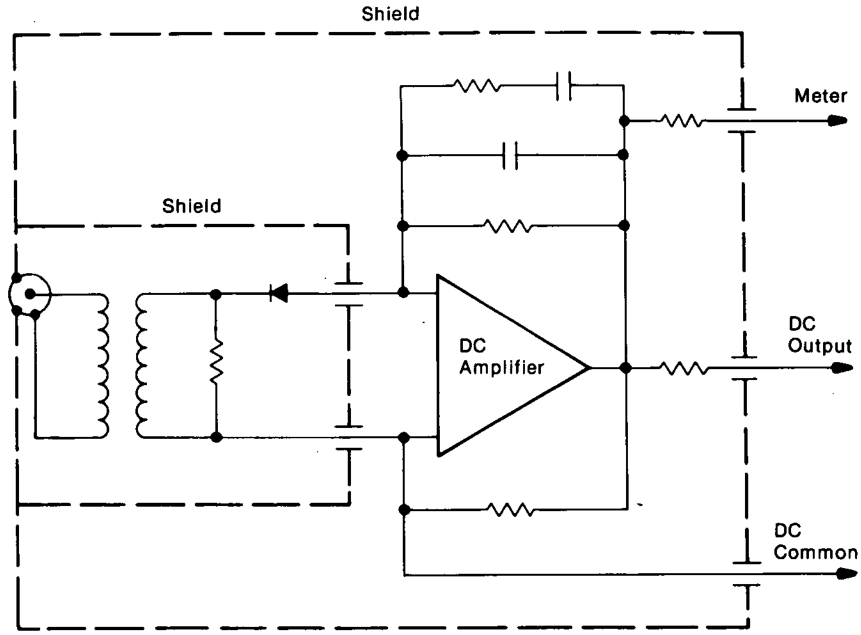

Figure 2. Diode Detector and DC Amplifier

enclosures are through capacitive feedthrough connectors. The inner shielded box contains the tunnel diode and an isolation transformer.

The square-law response of the detector has been measured to show output error in decibels for a 1-dB input-level change as a function of output level. Results have shown that over the first 10 dB of detector dynamic range, the deviation from square law is 0.009 dB; whereas over the measured dynamic range (60-mV to 2-V output) of 15.6 dB, the error is 0.032 dB.

Full-voltage (to 99.9 percent output level) rise time of the detector is about 200 μs. Faster response low-drift amplifiers are now becoming available, and it is expected that this response time will soon be lowered to less than 10 μs.

In thermal stability tests, results showed that for a step change in temperature of 25° C, the settling time of the detector was approximately 60 min., and typical peak transient deviations were approximately 200 μV.

Note:

Requests for further information may be directed to:

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Reference: TSP75-10180

Patent status:

NASA has decided not to apply for a patent.

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